

CLAIMS

1. A microwave dental system comprising:

5 a hand-held dental tool including:

an antenna positioned at a distal end of the tool and configured to be selectively positioned within a mouth of a patient adjacent at least one exterior surface of a tooth; and

10 a waveguide connected to the antenna;

15 a source of microwave energy operably coupled to the waveguide, including a control system for controlling delivery of microwave energy to the waveguide.

such that the dental tool delivers microwave energy to the at least one exterior surface of the tooth.

2. The microwave dental system of claim 1 wherein control system controls the source of microwave energy to deliver less than 10 W to the antenna.

3. The system of claim 1 wherein the control system operates the source of microwave energy at voltages in a range of between 10 and 65 V.

4. The system of claim 1 wherein the control system operates the source of microwave energy at frequencies of between 1 GHz to 50 GHz.

5. The system of claim 4 wherein the control system operates the source of microwave energy at frequencies between 14 GHz to 24 GHz.

6. The system of claim 1 wherein the control system includes a feedback sensor and the microwave energy is applied to allow the feedback sensor to detect caries.

7. The system of claim 1 wherein the microwave energy is applied by the control system at a frequency and power to preferentially heat caries.

8. The system of claim 1 wherein the microwave energy is applied to polymerize a resin matrix to create a dental composite.

9. The system of claim 8 wherein the resin matrix is comprised of polyfunctional methacrylate esters and oligomers including Bis-GMA and microwave sensitive initiators.

10. The system of claim 8 wherein the hand-held tool further includes a mechanism to deliver 5 the resin matrix to the tooth.

11. The system of claim 1 wherein the microwave energy is applied as part of a non-invasive procedure.

10 12. The system of claim 1 further comprising means for providing cooling to the hand-held tool during the application of microwave energy.

13. The system of claim 1 wherein the antenna further includes an antenna choke made of microwave absorbing materials.

15 14. A microwave dental system comprising:  
a hand-held dental tool including:  
an antenna positioned at a distal end of the tool and configured to be selectively positioned within a mouth of a patient adjacent at least one tooth; and  
a waveguide connected to the antenna;  
a source of microwave energy operably coupled to the waveguide, including a control system for controlling delivery of microwave energy to the waveguide such that less than 10 W of microwave energy is delivered to the antenna at frequencies between 1 GHz to 50 GHz.

20 25 15. A microwave dental system comprising:  
a hand-held dental tool including:  
an antenna positioned at a distal end of the tool and configured to be selectively positioned within a mouth of a patient adjacent at least one tooth; and  
a waveguide connected to the antenna;  
a source of microwave energy operably coupled to the waveguide, including a control system for controlling delivery of microwave energy to the waveguide, the control system including a feedback sensor such that the microwave energy is applied to the tooth to allow the feedback sensor to detect the existence of caries in the tooth.

16. A microwave dental system comprising:  
a hand-held dental tool including:  
an antenna positioned at a distal end of the tool and configured to be  
selectively positioned within a mouth of a patient adjacent at least one tooth, the  
antenna including an antenna choke to restrict transmission of microwave energy to  
surrounding tissue; and  
a waveguide connected to the antenna;  
a source of microwave energy operably coupled to the waveguide, including a  
control system for controlling delivery of microwave energy to the waveguide.

10 17. A method for intra-orally treating caries comprising:  
identifying a carious lesion in a tooth in a patient's mouth; and  
using a hand-held dental tool to intra-orally apply microwave energy to at least one  
exterior surface of the tooth to non-invasively treat the carious lesion.

18. The method of claim 17 wherein the hand-held tool includes a sensor for measuring  
microwave energy absorbed by a tooth and wherein the carious lesion is identified by determining  
an amount of microwave energy absorbed by the tooth indicative of a carious lesion.

20 19. The method of claim 17 further comprising:  
applying a sealant to the tooth after the application of microwave energy.

25 20. The method of claim 17 wherein a portion of the carious lesion is mechanically removed  
prior or after to the application of microwave energy.

21. The method of claim 17 further comprising:  
applying a resin matrix to the tooth; and  
using the hand-held dental tool to polymerize the resin matrix.

30 22. The method of claim 17 wherein hand-held tool includes an antenna that is operatively  
coupled to a source of microwave energy by a waveguide and wherein the source of microwave  
energy is operated to deliver less than 10 W of microwave energy to the antenna.

35 23. The method of claim 22 wherein the source of microwave energy is operated at voltages in a  
range of between 10 and 65 V.

24. The method of claim 22 wherein the source of microwave energy is operated at frequencies of between 1 GHz to 50 GHz.

5 25. The method of claim 24 wherein the source of microwave energy is operated at frequencies between 14 GHz to 24 GHz.

10 26. A dental composite intra-orally polymerized by application of microwave energy from a hand-held dental tool, the composite being comprised of polyfunctional methacrylate esters and oligomers including Bis-GMA and microwave sensitive initiators.

27. The dental composite of claim 26 further comprising disinfectant materials.

28. The dental composite of claim 26 further comprising microwave absorbing materials.